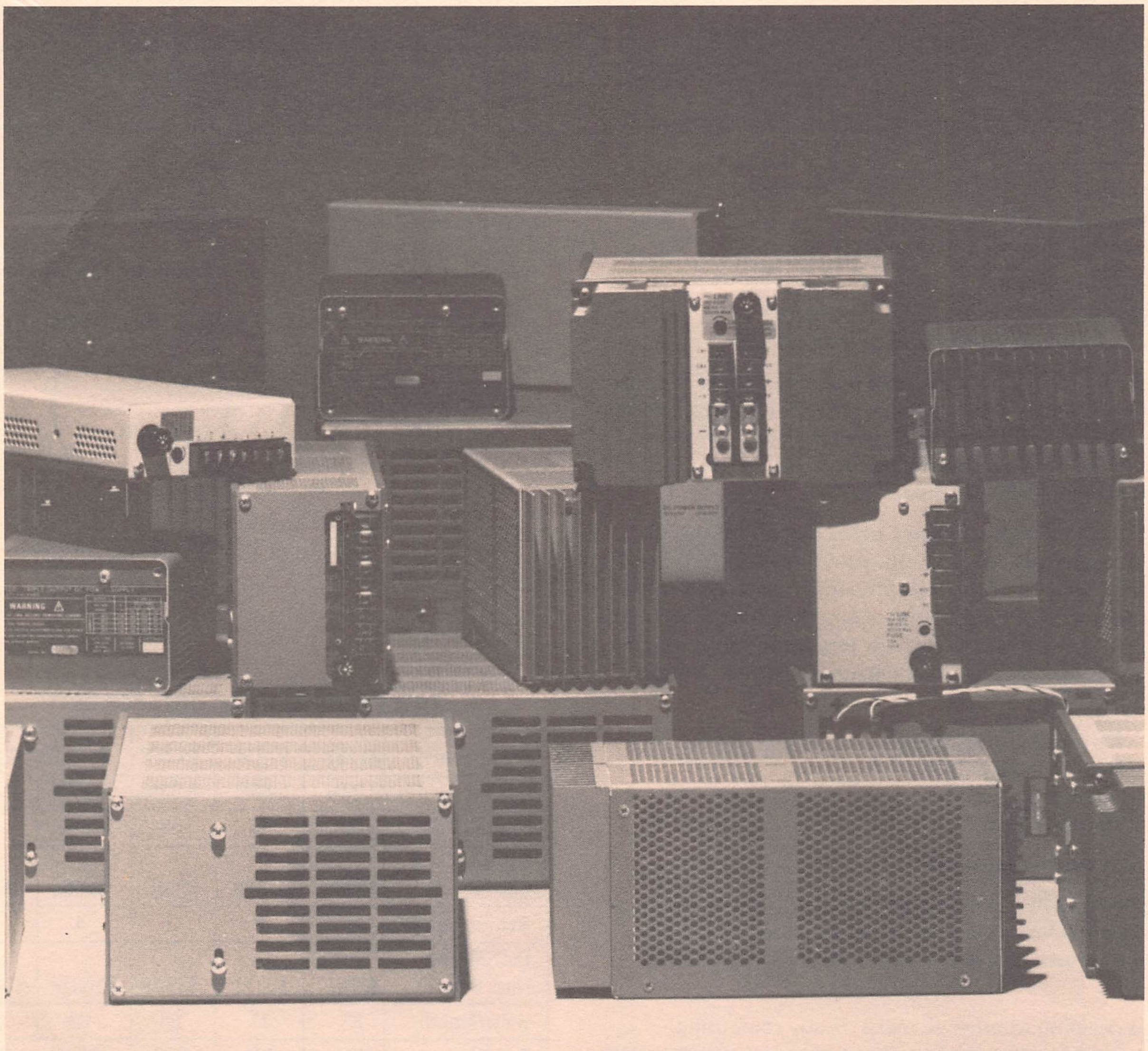
APPLICATION NOTE 236-1

A "MAKE" OR "BUY" ANALYSIS FOR POWER SUPPLIES



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A careful cost analysis will at some point isolate and list the most expensive components of a system for scrutiny. The power supplies that run the system often end up on this list. The question frequently asked then is whether to purchase the power supplies or build them. Though entire textbooks have been written, courses given, and hundreds of articles published on the subject, many still grope for evaluation criteria. It seems straightforward enough that the cost to purchase should be compared with the cost to build, and whichever alternative is cheaper is the one to follow. This is true – but the question remains: What are the real costs of building power supplies?

Labor, material, and overhead are the customary criteria for assessing manufacturing cost. But there are a number of hidden costs, and though real, some of them are much more elusive. For example:

Inventories:

Will they increase or decrease?

What will the carrying cost be?

Overhead:

What overhead cost does a power supply manufacturer have?

Does my overhead automatically increase my cost over his?

Warranty:

How much cost will it add?

Do other support costs increase?

Investment Capital:

What kind of return can be expected?

Is this the best alternative for investment?

Obviously building a power supply does make sense at some production volume. The following analysis can help ascertain the volume at which the decision to make your own power supplies (state-of-the-art switching supplies in particular) becomes economically justified.

Small size and high efficiency often dictate the use of switchers in systems. As a result, many buy decisions are being made because of the high investment and level of technical expertise required to design them. Putting the technical factors aside, this article deals with four important economic factors to be considered before deciding whether to make or buy. They are:

I. Return on Investment
II. Manufacturing Cost
III. Inventory Cost
IV. Warranty Cost

I. Return on Investment

Judgement criteria of what constitutes a proper return on invested capital lie in the eyes of the beholder. Generally, the level of return is proportional to the amount of risk involved.

When deciding whether to make or buy something, decisions are too often made without studying alternate uses of capital. For example, Corporation X, which has been highly successful developing real estate, decides it is spending too much for road construction contracts. It spends $500,000 for equipment, hires a construction crew, and estimates it will double the investment in profits over the next four years. A wise investment? Twenty-five percent per year doesn't sound bad. However, if you consider the fact that they had been tripling their invested capital every three years, it sounds horrible. Investments should be made with regard for the return a corporation expects to make in its field of expertise. With this in mind, let's set up an analysis procedure that relates investment level and return factor to unit cost.

First, it is necessary to define the terms to be used in the analysis.

Present Value (P) – The estimated total investment in product development.

Interest Rate (I) – The cost of borrowed capital.

Period (N) – The estimated life (in months) of the end product for which the power supply is being developed.

Capital Cost Per Month (R) – The payment that would amortize a given investment over (N) periods at interest rate (I).

Return Factor – The summation of profits over a given period divided by the initial investment.

Now let's look at a typical problem:

What is the investment cost per unit based on an initial investment of $125,000 and an interest rate of 10%, for return factors of one, two, three, four, and five. The life of the end product is five years, with estimated sales of 1000 units per year.

Initial Investment = $125,000

Interest Rate = 10%/year (0.83%/month)

Period = 5 years (60 months)

Monthly capital cost (R) $= P\left(\frac{I\,(1+I)^{N}}{(1+I)^{N}-1}\right)$

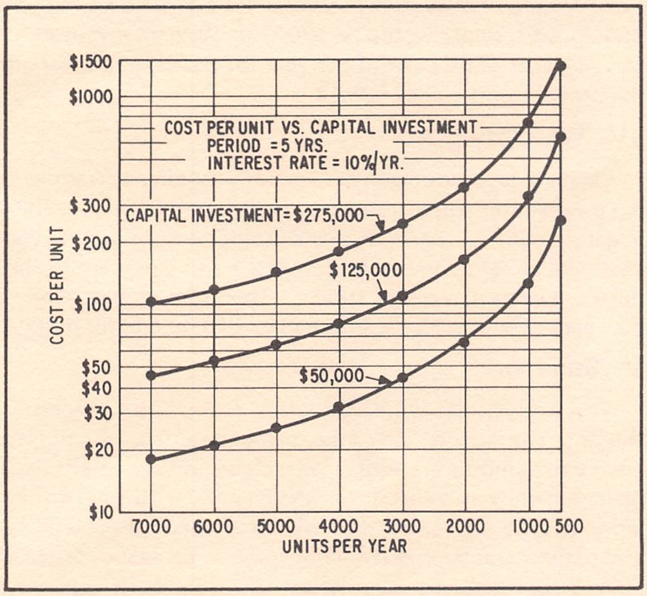
= 2655.88

Units per month $= \frac{1000/\text{year}}{12} = 83.33$

TABLE I. INVESTMENT COST PER UNIT

Investment	$125K	$125K	$125K	$125K	$125K
Interest/Month	0.83%	0.83%	0.83%	0.83%	0.83%
Period (Months)	60	60	60	60	60
Capital Cost/Month	$2656	$2656	$2656	$2656	$2656
Return Factor	1	2	3	4	5
Cost/Month (Incl. Return)	$2656	$5312	$7968	$10624	$13280
Units/Month	83	83	83	83	83
Cost/Unit	$32	$64	$96	$128	$160

Using one's own criteria for what constitutes a proper return, the same analysis can be used to convert investment dollars into unit cost. The figure below shows unit costs based on investments of $50,000 to $275,000 and quantity requirements of 500 to 7,000 per year. A 5-year life and 10-percent interest rate were used to derive the curves.



II. Manufacturing Cost

Power supplies, especially those used by OEM's are extremely price sensitive. Power supply manufacturers are under continual price pressure both from competitors and from OEM's opting to build rather than buy. As a result, companies in the power supply business must run highly efficient operations in order to be profitable.

A typical power supply sold on a large OEM agreement has a cost of goods sold in excess of 60 percent of the selling price. This figure is based on reported financial statements of several major power supply manufacturers. Manufacturing overhead rates for these same manufacturers vary from as low as 125 percent to as high as 200 percent of the labor cost, with the typical rate at about 150 percent. Material percentages also vary from one manufacturer to another, but are typically a minimum of 33 percent of the discounted selling price on a large contract.

Let's examine then what the distribution of labor, material, and overhead is in the total manufacturing cost. If the sum of labor, material, and overhead (manufacturing cost) is 60 percent of the selling price and the cost of material accounts for 33 percent, that leaves 27 percent to cover labor and overhead. Assuming an overhead rate of 150 percent of the labor cost, that 27 percent breaks down to 10.8 percent for labor and 16.2 percent for overhead. The distribution of a 60 percent manufacturing cost expressed as a percent of the discounted selling price is then:

Labor	10.8%
Overhead	16.2%
Material	33%
Total Mfg. Cost	60%

With this in mind, let's analyze what happens to the manufacturing cost with different overhead rates applied.

TABLE II. MANUFACTURING COST VS. OVERHEAD

Overhead Rate	150%	200%	250%	300%	350%
Labor	10.8%	10.8%	10.8%	10.8%	10.8%
Overhead	16.2%	21.6%	27.0%	32.4%	37.8%
Material	33.0%	33.0%	33.0%	33.0%	33.0%
Manufacturing Cost	60.0%	65.4%	70.8%	76.2%	81.6%

Assuming all manufacturers are equally efficient with labor and materials, manufacturing costs will be between 60 and 81.6 cents on the dollar depending on their overhead rate.

III. Inventory Costs

To estimate the cost of inventory for make-versus-buy, two factors must be calculated: the cost of carrying inventory, and the incremental inventory for the decision to make.

1. Inventory Carrying Costs

Generally speaking, inventory carrying costs can be broken into two entities. First is the cost of lost opportunity for the dollars involved. Second is the direct cost for storage, handling, taxes, insurance, and obsolesence.

a. Cost of Lost Opportunity. Establish an actual or desired inventory level in dollars for a given business. Divide this number into the annual sales to get an inventory turnover rate. The turnover rate times the profit per turnover is the opportunity for the investment.

Example:

Annual Sales	$1,200,000
Inventory	$ 400,000
Turnover	3
Net Profit/Shipment	10%
Opportunity	30%/year

In this example, inventory dollars should be valued at the rate of 30 percent per year for the opportunity they represent. An incremental dollar invested without incremental shipments represents a lost opportunity, and the cost of that lost opportunity is 30 percent per year.

b. Direct Cost of Inventory. The costs of storage, handling, taxes, insurance, and obsolesence are all directly associated with given inventory levels. The cost these represent is on the order of 20 to 25 percent per year according to most textbooks. The exact cost varies with the type of building, labor rates, local taxes, etc., but the previously mentioned range of 20 to 25 percent per year should still hold.

To summarize the cost of carrying inventory, you have to add the direct costs to the cost of lost opportunity. A fair estimate for direct costs is 20 to 25 percent per year. The cost of lost opportunity can vary widely, depending on profit and turnover, but a reasonable range would be between 20 and 50 percent per year. The combined inventory cost would then range from 40 to 75 percent per year. The number used in the remaineder of this analysis is 60 percent.

2. Incremental Inventory

For the sake of simplicity, inventories can be classified into three categories. They are: (1) purchased parts (including raw materials), (2) work in process, and (3) finished goods. When a power supply is totally assembled, checked out, and ready for use, it can be considered finished goods for the purpose of make-or-buy analysis.

Graphically, the inventory dollar build-up and use of a power supply has a shape of Figure 1 for a make decision and that of Figure 2 for a buy decision. The incremental inventory is the purchased part and work-in-process build-up prior to use.

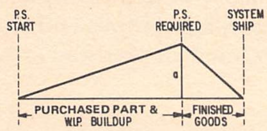


Fig. 1. Inventory Profile For a Make Decision.

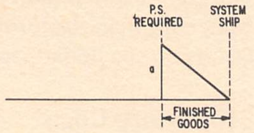


Fig. 2. Inventory Profile For a Buy Decision.

The height (a) of the inventory curve varies depending on the decision to make or buy. Assuming from Table II that the overhead rate is 300 percent (typical for an OEM), the manufacturing cost is 76.2 percent.

For every $100 of purchase price, then, it costs $76.20 to make rather than buy. If the power supply is required (X) weeks before system shipment, the make curve approximates Figure 3 and the buy curve, Figure 4.

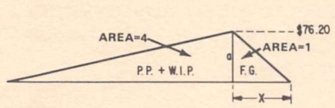


Fig. 3. Make

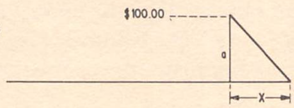


Fig. 4. Buy

Looking more closely at Figure 3, the ratio of the area under the curve for purchased parts and work-in-process to the area for finished goods must be determined. This can be accomplished by looking at the distribution of inventories as they currently exist in the facility of the analyst. Making the assumption that finished goods represent 20 percent of the total inventory, the ratio is 4:1, and the curve is shaped as in Figure 3.

Looking at these two inventory curves in a time series as in Figure 5, the inventory level for a make decision approximates 3.8 times that of the buy. For every $100 of purchase price, the inventory level increases $140.50.

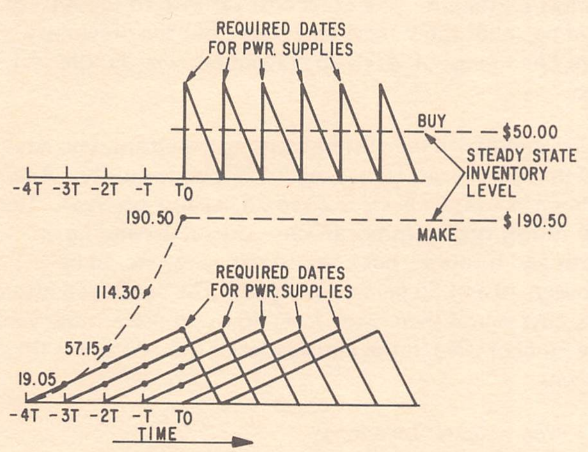


Figure 5. Steady State Inventory Level

For example, the inventory increase for a make decision on a $500 power supply would be $702.50. With an inventory carrying cost of 60 percent per year (or 5 percent per month), the cost per unit equals $35.13.

IV. Warranty Costs

"Make" decisions incur the cost of assuming warranties on the power supply used. Although small with respect to the costs already discussed, warranty costs should be considered. Warranty costs can be estimated to be between 1 and 3 percent of the purchase price of a power supply. Therefore, the incremental cost approximates $2 per hundred or $10 on a $500 supply.

V. Summary

This analysis has avoided mention or inclusion of such things as risk factors, cash flow, plant capacities, or any other areas where inputs are subjective. These considerations should be included when a specific case is analyzed. However, they are so heavily dependent on a company's expertise, stability, and current status, that it is impossible to generalize about them.

The four elements that can be objectively evaluated, though, are (1) return on investment, (2) manufacturing cost, (3) inventory cost, and (4) warranty cost. The effect of each on unit cost can be determined as outlined in Sections I thru IV. An example of the cumulative effect of these costs is summarized in the following example:

Decision:	Make or buy a 350W multiple-output switching supply?	
Knowns:	Engineering Investment	$125,000
	Return on investment factor	3
	Manufacturing Overhead	300%
	Finished Goods Ratio	20%
	Interest Rate/Year	10%
	Purchase Price	$500
	End Product Life	5 Years

TABLE III. SUMMARY

Costs ($)	Usage/Year				
	500	1000	1500	2000	3000
Return on Investment	190	96	64	48	32
Manufacturing Cost	381	381	381	381	381
Inventory Cost	35	35	35	35	35
Warranty	10	10	10	10	10
Total Make Cost	616	522	490	474	458
Purchase Cost	500	500	500	500	500
Net Difference	–116	–22	+10	+26	+42

In this example the break-even point whould be an estimated usage of 1292 units per year for 5 years. This would yield a return on investment of three. Now a probability can be assigned to the usage per year number to establish confidence limits for the decision.